Chapter 6
Sample Collection

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6.10 Biological Sampling Procedures

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6.1 General Information Applicable To All Sampling Events

This chapter details many of the step by step procedures to be followed during the collection of environmental samples from various matrices. The use of different kinds of sampling equipment dictates that different factors must be considered for each type of sample collected. Some factors concerning sample collection, however, remain the same regardless of the sample's matrix or device used. This non-site specific information comprises the first part of this section. For site-specific considerations, contact the appropriate regulatory authority. The general information in presented here, when used with information in any of the other sections of this chapter and as dictated by the site-specific conditions, will allow the most representative sample to be collected in a safe and efficient manner.

6.1.1 Preparation

Thorough preparation before the initiation of a sampling event is undoubtedly one of the most important steps in the sampling process. Additional costs can be incurred if sampling must be continued on another day or completely re-done due to inadequate or improper preparation. Therefore, equipment lists should be prepared and personnel needs should be projected. In cases where it is questionable which type of sampling device will work best, several should be on hand. If potential obstacles to the timely completion of the job exist, extra personnel should be scheduled.

In addition to procurement of the appropriate equipment, sampling preparation includes assuring that equipment is in good working condition and properly decontaminated. The sampling device should be cleaned per one of the approved methods described in Chapter 2 and properly prepared for transport to the site. Care must be taken in transporting and storing cleaned sampling equipment. Equipment should never be stored or transported in the same vehicle used to transport generators, gasoline or decontamination solvents. Under such conditions cross-contamination is likely to occur.

The material of construction for sampling equipment should be PTFE or stainless steel (see Chapter 5. *Sampling Equipment*, 5.1 *Introduction*). Each sampling device should be used to collect one sample. In some cases, the use of dedicated samplers may be impractical. When collecting numerous surface soil samples (using trowels) or subsurface soil from boreholes (using direct push or split spoon samplers) it may be necessary to decontaminate equipment in the field. An equipment decontamination area must be set up to accomplish this. The decontamination area should be established in a non-contaminated zone and should consist of chemical resistant buckets placed on clean plastic sheeting. Solutions required for equipment decontamination must be on-hand and should be in easy to use squirt bottles. Assorted heavy-duty scrub-brushes must be available. All rinse fluids must be collected and provisions made for their proper disposal.

When decontaminating equipment in the field, extra care must be taken to assure thorough cleaning. Because of the difficulty encountered in cleaning bailers, field decontamination is not allowed for this piece of equipment. Bailers must be laboratory cleaned, wrapped and dedicated to each well for each day's sampling.

In addition to the site specific decontaminated sampling device, other equipment is necessary during the execution of a sampling event, which may include but not be limited to:

- Lab-cleaned sample containers of the proper size and composition provided by the laboratory performing the analysis.
- Quality control samples (e.g., field and/or trip blanks, duplicates, performance evaluation samples).
- Bound field logbook, and camera.
- Appropriate paperwork (e.g., Chain of Custody, Logging and Calibration forms).
- Sample labels.
- Reagents, preservatives, coolers and a means to maintain sample temperature at 4ºC.
- Portable instrumentation (e.g., Geiger counter, explosimeter, oxygen level monitor, photoionization detector, flame ionization detector, flow through cell).
- Narrow range pH paper, that is within the "Use By" time frame indicated by the manufacturer, to check the pH of preserved samples.
- Appropriate personal safety equipment (e.g., disposable gloves, eye protection, and respirators).
- Decontamination equipment for personnel and/or equipment.
- Absorbent pads.
- Plastic bags for containerizing contaminated items.
- Packaging materials for sample shipment and custody seals for shuttles. This includes appropriate shipping containers that meet either USDOT or USDOT/IATA standards depending upon the "dangerous goods" classification for packaging and shipping samples to the laboratory.

Finally, one must plan for all other equipment needed to meet specified requirements in the sampling plan and the Technical Requirements for Site Remediation. Examples include equipment used to determine the depth of sample, pH, temperature, and dissolved oxygen content of aqueous samples, or the instrumentation necessary to determine the geographically referenced location of any sample.

6.1.2 Type of Samples

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6.1.2.1 Environmental and Waste Samples

Environmental: samples of naturally occurring matrices such as soil, sediment, ground water, surface water and air.

Waste: samples, which are comprised of process waste or other man-made materials.

Making the distinction between environmental and waste samples is important when it comes to choosing sampling equipment, the material of construction (see Chapter 5), personal safety precautions, and for complying with transportation requirements. For waste samples, the volumes needed by the laboratory for certain analysis can be reduced thus minimizing the volumes collected in the field and disposal issues for the laboratory. The actual volumes of waste samples needed by the laboratory should be determined and detailed in the QAPP.

Environmental and waste samples have the potential to contain significant amounts of hazardous materials. Since these samples pose a safety threat, they should be designated, handled and shipped as dangerous goods according to U.S. Department of Transportation regulations (see Chapter 11, *Sample Shipment*).

6.1.2.2 Grab vs. Composite

Grab sample: a discrete aliquot that is representative of one specific sample site at a specific point in time. Since the entire sample is collected at one particular point and all at one time, a grab sample is representative only of those static conditions. If the source or condition is fairly consistent over a period of time and/or geographical area, the grab sample can be considered to be fairly representative. However, for sources that vary greatly over time, distance or area (e.g., release of contaminants into moving water or air) the representativeness of a grab sample is not as easily discernable.

Composite sample: a non-discrete sample composed of more than one specific aliquot collected at various sampling points and/or at different points. Composite samples may give an "average" concentration or composition over time or area. When compositing is performed the concentration of contaminant in individual grab samples may be diluted proportionately to the number of samples taken. Not only is contaminant dilution possible, the detection limits for each individual sample may be raised proportionally by the number of samples added to the composite. For instance, if a sampler wishes to composite two discrete samples into one and the method detection limit for a target compound were 330 ppb, the detection limit for the target compound does not change for the composite. However, the detection limit for the compound in the individual samples, which make up the composite is two times the normal detection limit or 2 x 330 = 660 ppb. This is important to keep in mind because if a contaminant were present in only one of the two composited samples, and if it were at a level between 330 and 660 ppb, that contaminant would not be quantified or possibly even identified due to the effective dilution of the contaminant concentration in the composite. This concept should be taken into account when determining the data quality objectives of a composite-sampling event, to ensure that useful data is collected. It is advisable that if a positive identification is made in the course of analyzing a composite sample, that the discrete samples then be analyzed individually to determine the true distribution of contaminant throughout each component of the composite.

When collecting samples at hazardous waste sites for the Site Remediation and Waste Program, grab sampling should be the chosen method. While composite samples may have merit when performed for specific purposes and under known conditions, the risks involved may be great (mixing unknown/reactive waste) and the information provided not particularly useful. To improve the quality of the composite sample, follow the compositing considerations offered in ASTM D6051-96 *Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities*. Two possible homogenization options to consider for soil are the cone and quarter technique or use of a riffle splitter. For aqueous samples use of a churn splitter may be a suitable option.

Compositing samples may pose a potential safety risk when samples of unknown content are combined. Changes in the chemical nature of the sample may occur as a result of this combination causing the sample to be non-representative of actual field conditions for a particular time or location. Additionally, contaminants in one aliquot of sample may be masked when this portion is composited with other, cleaner aliquots.

If compositing is allowed in site specific instances, it should occur in the laboratory for hazardous samples, and in the field for wastewater or stormwater samples. Samples should be composited on a weight/weight or volume/volume basis under controlled conditions. Be aware that there are no formal laboratory methods for compositing samples at the laboratory, so procedures will vary from laboratory to laboratory and possibly within a laboratory. Always keep in mind that consistency helps to ensure comparability of data.

Note: For discussion on duplicate, split, and other QA/QC sample collection requirements see Chapter 2.

6.1.3 Laboratory Procurement

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The analytical needs associated with the collection of samples should be clearly defined in the site-specific sampling plan. Important information regarding the data quality objectives, analytical methods to be employed, turnaround times, deliverables, and funds available must be specified. When choosing a lab, these factors act as a guide. Additional considerations include:

- whether the lab has maintained the required certifications and approvals for specific parameters for which samples are to be analyzed.
- whether the lab is available to perform the analysis requested.
- whether the lab has the capacity to handle all the samples that will be delivered.
- whether the lab can perform the analysis within the time frame specified (if applicable).
- the lab's proximity to the site or capability to pick up and deliver as needed.
- whether the lab provides DOT/IATA shipping containers and packaging materials.

6.1.4 Quality Assurance Samples

When advising the chosen laboratory of the required analyses, specifications regarding quality control samples should be relayed. The lab should be informed as to the rate of inclusion of trip and field blanks, how this water should be provided (e.g., identical sets of filled and empty bottles for field blank collection), the requirements for the quality and origin of the blank water (e.g., the same as the method blank) and the analysis desired (see Chapter 2) for the associated blanks.

The laboratory's procedure for bottle preparation and storage, blank preparation and mechanism for transport and maintenance of temperature should be evaluated and the associated paperwork should be reviewed for adequacy.

Quality assurance considerations must be addressed prior to sampling. If upon initiation of the sampling it is discovered that one or several quality assurance considerations have not been properly addressed, no sampling should occur. In such a situation, with personnel and equipment on standby in the field, the importance of effective communication with the lab is crucial.

6.1.5 Quality Assurance Project Plans

Since sampling situations vary widely and no universal sampling procedure can be recommended, it is important that a sampling plan or quality assurance project plan be developed per regulatory authority requirements. As stated in Chapter 2, all regulatory programs require the submittal to and approval by the Department of a QAPP prior to the sampling. Please refer to Chapter 2 for the Quality Assurance Project Plan Requirements

6.1.6 Assuring Health and Safety

The health and safety of sampling and support personnel is the most important priority during collection operations. Appropriate portable monitoring devices, which have been properly calibrated, should be used by properly trained personnel to monitor site conditions. A complete Health and Safety Plan should be developed based on information gathered during the file search and instrument readings from the pre-sampling site visit. This Plan should detail potential hazards, instruments to be used, their calibration and use, level of protection to be worn by personnel during various on-site activities, emergency services locations and phone numbers, etc. To assure

health and safety in unknown situations (e.g., sites with little available historic information or in initial entry situations) a worst case scenario should always be assumed until instruments confirm otherwise. (See Chapter 4, *Site Entry Activities*.)

For example, test pit excavation sampling or the sampling of containerized materials, may initially require level B personal protection. The results of continuous air monitoring may determine that downgrading personnel protection is acceptable.

6.1.7 Post Sampling Activities

There are several steps to be taken, even after the transfer of the sample into the sample bottle, that are necessary to properly complete collection activities. Once the sample is transferred into the appropriate container, the bottle should be capped and, if necessary, the outside of the bottle should be wiped with a clean paper towel to remove excess sampling material. The bottle should not be submerged in water in an effort to clean it. Rather, if necessary, a clean paper towel moistened with distilled and deionized water may be used.

The sample should be preserved immediately (4ºC and/or with appropriate reagent as detailed in the approved QAPP), properly labeled, properly packaged for transportation and custody sealed. Information such as sample number, location, collection time and sample description should be recorded in the field logbook. Associated paperwork (e.g., Chain of Custody forms, Sample Analysis Request forms) should then be completed and should stay with the sample. The samples should be packaged in a manner that will allow the appropriate storage temperature to be maintained during shipment to the lab. Samples should be delivered to the lab so the proper temperature level is assured and analytical holding times are not exceeded.